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SPECIFICATION

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MANIPULATOR-GUIDED GRIPPING DEVICE

The present invention pertains to a manipulator-guided gripping device with the features in the preamble of the principal claim.

Such a gripping device for vehicle body parts in body framing and paneling is known from DE 200 04 369 U1. The gripping device is guided by a multiaxial industrial robot. Such devices are used in partially or fully automatic plants or cells for body framing and paneling or in other technical areas. Collisions and crashes may occur here, in which the gripping device may be damaged. Such damage leads mostly to a change in geometry. For example, gripping parts that are relevant for function or the component, for example, tensioners, grippers, alignment pins or shearing pins, centering pins or the like may now be bent, twisted or brought out of their desired position in another way. This may also happen due to deformation of the gripper frame. Crashes are recognized and reported in practice by monitoring the motor current of the robot axis drives. However, this operates reliably only in case of violent collisions, which propagate to the robot drive. Minor collisions with weaker forces, which are mostly absorbed extensively by the yielding of the gripping device or parts thereof, cannot be recognized by monitoring the motor current. However, such minor collisions nevertheless lead to damage to and malfunction of the gripping device, which in turn entails errors in the machining process and on the body shell. In case of the above-mentioned major collisions, which are detected and signaled by monitoring the motor current, the gripping device is replaced and repaired. The gripping device must be removed to

identify and repair the unknown damage, set up completely and remeasured. This is a very complicated operation and can be carried out only outside the gripper operation. The object of the present invention is to show a gripping device that shows a better behavior in case of crashes and collisions.

The object is accomplished with the features in the principal claim.

The claimed deflectable safety device at the various components or parts of the gripping device, which safety device is preferably present as multiple devices, has the advantage that it makes possible the deflection of the colliding parts of the gripping device in case of a crash or collision, as a result of which plastic deformations and other damage are avoided on the gripping device. Due to the deflected position, it is, moreover, optically signaled to an operator that a collision has taken place. In addition, suitable detectors or sensors may be present at the deflectable safety device, which detect a deflecting movement and report it in a suitable manner, for example, signal it to a process control, automatically trigger an alarm or the like.

The deflectable safety device is preferably arranged at a connection point between the different device parts of the gripping device. The device parts, for example, frame tubes, may also be divided, in which case a deflectable safety device is arranged between the tube sections. The deflectable safety device may be located as a result at the points of the gripping device that have been shown by experience to be loaded most heavily and are also critical. Depending on the geometry of the gripping device, the positions of the different deflectable safety devices are selected to be such that the colliding device part can be deflected immediately in case of a collision,

and deformations and damage are avoided in this part as well as on the other components of the gripping device.

The deflectable safety device may connect the device parts with clamping and frictional connection or with deflectable positive-locking connection. An adjusting means makes possible the reproducible positioning of the device parts in the initial device and also during the repositioning after a crash. The detector may be a part of the adjusting means. The moving device part can again be returned into its desired position after the deflection. As a result, the gripping device can continue to be used without complicated measurement and resetting.

If the deflectable safety device is provided with a locking element for positive-locking guiding, it is thus also possible to exactly define the desired position and to position the device parts. The locking element is preferably spring-loaded, and the overload or load threshold generated by collision, beginning from which deflection is to take place, can be set by means of the spring mounting. The deflectable safety device is rigid and dimensionally stable below this threshold, so that it does not compromise the function and the geometry of the gripping device. The holding frictional force can be set by a controlled clamping connection in case of a frictionally engaged connection.

From a design viewpoint, the deflectable safety device may have various designs. It preferably comprises at least two safety device parts, which may be designed, for example, as a sphere each with a socket surrounding it or as disk mounts with parallel working surfaces. A plurality of locking elements, which may be designed, for example, as spring-loaded balls or the like, are

preferably located between the safety device parts. By selecting the geometry of the safety device parts and of the locking elements correspondingly, the deflectable safety device can make possible deflection along one or more defined axes in case of a collision.

Other advantageous embodiments of the present invention are described in the subclaims.

The present invention is schematically shown in the drawings as an example. Specifically,

Figure 1	shows a side view of a robot with a gripping device with a plurality of deflectable safety devices;
Figure 2	shows a top view of the gripping device according to arrow II in Figure 1;
Figures 3 and 4	show longitudinal sections of two design variants of the deflectable safety device;
Figures 5 through 10	show longitudinal and cross sections of three more design variants of the deflectable safety device; and
Figure 11	shows a cut-away side view of the adjusting means and of the detector of the third variant according to Figures 9 and 10.

Figure 1 shows a schematic side view of a machining station for workpieces, which are held and

guided by a mechanical manipulator (2) by means of a gripping device (1). The workpiece, which is not shown for clarity's sake, may be of any desired type whatsoever. It is preferably a body part of a body shell, for example, a side panel part or the like. The manipulator (2) is preferably designed as a multiaxial industrial robot, especially as a six-axis articulated arm robot. The workpieces can be picked up, transported, brought into defined positions and locations and aligned as well as again deposited with the gripping device (1). These manipulation processes can take place fully automatically by means of a control (26). This is, e.g., a process control, which is integrated in the robot control. As an alternative, it may also be arranged externally. It may also be located at the gripping device (1) according to Figure 2.

Figure 2 shows a bottom view of an exemplary embodiment of a gripping device. The gripping device (1) may be designed corresponding to DE 200 04 369 U1 and has a frame (4), which can be detachably connected to the robot hand (3) by means of a usually central docking part (5). The frame (4) comprises, for example, a plurality of frame tubes (7, 8) or other support elements, which may be arranged in parallel as a lightweight supporting frame and cross-connected to one another at a plurality of points. The tubes (7, 8) are connected to the docking point (5) designed as a support plate by means of clamps or the like. Clamping elements, gripping elements, component centering means or the like, which assume a gripping or guiding function, are arranged at the frame (4) and the tubes (7, 8) thereof at a plurality of points. These may be, for example, tensioners with contour support elements, vacuum grippers or other similar elements. The frame tubes and the tensioners, grippers and the like will hereinafter be called uniformly device parts (6, 7, 8).

The gripping device (1) is designed, for example, as a so-called geogripper, in which all device

parts (6, 7, 8) have an exactly defined position and orientation. The geogripper is exactly adapted to the geometry of the workpiece to be manipulated.

The gripping device (1) has a safety means (9), which responds in case of a crash and collisions with the external environment. The safety means (9) has at least one, preferably a plurality of deflectable safety devices (10), which are arranged at the device parts (6, 7, 8) and permit the deflection thereof in case of a collision. The deflectable safety devices (10) are arranged at a junction point (23) between the device parts (6, 7, 8).

Such junction points (23) are, for example, the connection points at which the device parts (6), i.e., the tensioners, grippers, component centering means or the like are connected to the frame (4). The deflectable safety device (10) is arranged here between the device part (6) and the frame (4). Other junction points (23) with a deflectable safety device (10) are located at the points of intersection of the frame tubes (7, 8), where these are connected to one another. On the other hand, one or more frame tubes (7, 8) may also be divided, in which case two, preferably aligned tube sections (7', 7") are arranged at the junction or junction point (23) at the deflectable safety device (10). Such divisions of the tube may be present at the points of the gripping device (1) that experience has shown to be subject to higher loads and are located, for example, at the tube sections projecting away from the docking plate (5). It is possible in another variant to provide the connection points between the frame (4) or the frame tubes (7, 8) with the docking point (5) with deflectable safety devices (10).

The deflectable safety devices (10) are rigid and dimensionally stable during normal operation.

They withstand all the static and dynamic loads occurring during normal operation. The deflectable safety device responds only when a collision of the gripping device (1) with an obstacle occurs and collision forces or overload develops, and the deflectable safety device now permits the deflection of the colliding device part (6, 7, 7', 7", 8).

The deflectable safety device (10) comprises at least two safety device parts (11, 12), which are mounted at each other such that they can be deflected in case of overload. The safety device parts (11, 12) may be connected by positive-locking connection as in the variants according to Figures 3 through 6 or by frictional connection according to the embodiment shown in Figures 7 and 8. An adjusting means (33) makes possible the reproducible mutual positioning of the safety device parts (11, 12) and consequently also of the corresponding device parts (6, 7, 7', 7", 8).

The positive-locking deflectable safety devices (10) according to Figures 3 through 6 are provided with a locking element (13), which makes possible the controlled deflection function and also acts as an adjusting means (33). The locking element (13) is preferably acted on by an elastic clamping element (20), which is adjustable.

The locking element (13) is located between the safety device parts (11, 12). The safety device parts (11, 12) are in turn connected to a device part [sic - Tr.Ed.] (6, 7, 8). This connection is exactly defined geometrically and can be set exactly, for example, by means of positioning pins (29), shearing pins or the like. The safety device parts (11, 12) can likewise be positioned exactly in relation to one other by means of the locking elements (13) and are secured and held in their positions by the locking element (13) and/or the clamping element (20). The force of the clamping

element (20) can be set and is adjusted in the above-mentioned manner to the static and dynamic forces acting during normal operation. The safety device parts (11, 12) yield in relation to one another only when a force threshold, which may optionally be set with a safety margin, is exceeded. The deflecting movement may take place along one or more axes depending on the embodiment of the safety device parts (11, 12) and of the locking element (13).
Figures 3 and 4 show two examples of design embodiments for a deflectable, positive-locking deflectable safety device (10), in which there are possibilities of deflection along four separate axes, which are illustrated in the drawings on the side by arrows. Figures 3 and 4 show the example of use at a junction point (23) between two tube sections (7', 7"). A corresponding design embodiment may also be present at other junction points (23), for example, between the device parts (6), i.e., the tensioners, grippers or the like, and the frame (4) or at points of intersection of the frame tubes (7, 8).

In the variant according to Figure 3, a safety device part (12) associated with the tube section (7") is designed as a sphere, namely, as a joint ball (15), which is attached to the tube end. A ring (15') with spherical circumference according to the variants of Figures 5 through 8 described below or another spherical part may also be used instead of a joint ball (15). The second safety device part (11) connected to the other tube section (7') by means of a metal fitting is designed as a socket (14), which surrounds and holds the joint ball (15) on the circumference. The socket (14) may have a straight tubular shape with a cylindrical or prismatic cross section, so that a linear contact with the circumference of the ball is possible with the joint ball (15).

The socket (14) and the joint ball (15) are held in contact with one another by the locking element

(13), which comprises in this case a plurality of locking balls (18), which are distributed on the circumference in the contact area and are acted on by a pressing spring (22) each as a clamping element (20). The locking balls (18) engage correspondingly shaped, exactly defined mounts (19) at the socket (14) and the joint ball (15) and thus secure the connection. Such ball/spring units may be screwed as ready-made machine parts into the socket (14). At least three, preferably four locking balls (18) are arranged in a uniformly distributed manner over the circumference of the ball on a line at right angles to the longitudinal axis of the tube section.

The embodiment according to Figure 3 makes deflection possible in four axes. When, for example, an upsetting or tensile force develops along the central axis of the two, preferably aligned tube sections (7', 7"), the tube section (7") with the joint ball (15) can be pulled out of or pushed into the socket (14) when the force acting is greater than the resultant, acting in the same direction, from the holding force of the radially [sic - probably a typo in German original for "radially" - Tr.Ed.] acting springs (22). The socket (14) has a sufficient clearance at the bottom against the joint ball (15) to absorb upsetting forces and upsetting movements. If, on the other hand, lateral forces act on one of the tube sections (7', 7"), the joint ball (15) can rotate correspondingly in the socket (14) about the vertical and/or horizontal axis for deflection. Torsional forces can also be absorbed by a deflecting movement and rotation about the longitudinal axis of the tube.

The mounts (19) may be designed with precision such that they permit the ball (18) to snap in only when it is in the exact position. As a result, a deflecting movement in case of collision is not abolished and returned by itself. The device parts (6, 7, 8) stop in the deflected position in relation to one another. The desired position and the locked position can, however, be restored by an

operator by manual engaging. As soon as all locking balls (18) engage their respective mounts (19), the desired position is exactly restored.

As an alternative, the mounts (19) may have an expanded shape at one of the safety device parts, for example, the joint ball (15), and form, for example, recesses or pans (28) with an enlarged radius of curvature. In case of such a shape or another suitable shape, the deflecting device part (6, 7, 7', 7", 8) can snap back by itself into the desired position after the collision.

As is also illustrated in Figure 3, the deflectable safety device (10) may have one or more detectors (24), which detect a possible deflecting movement and signal it in a suitable manner. They can report it to the control (26), for example, via the lines (25) shown in Figure 1. The detectors (25) may be designed, for example, as pressure sensors, which are associated with one or more locking balls (18) and record the movement behavior of these balls. The detectors (24) may otherwise be designed in any desired and suitable manner as force, motion or distance sensors or the like.

According to Figure 2, the control (26) may have a plurality of displays (41), whose number corresponds to the number of detectors, e.g., optical displays, for signaling the detector function and a possible deflection. As an alternative, the displays may be located at another point, e.g., at the deflectable safety devices (10). As a result, the operator can immediately locate the deflection point.

In the variant according to Figure 4, the two safety device parts (11, 12) comprise two disk mounts (16, 17), between the parallel working surfaces of which, which face each other, the locking

element (13) is arranged in the form of a plurality of locking balls (18) distributed in a circle. The locking balls (18) are preferably located in a common plane, in which the central axis of the two, preferably aligned tube sections (7', 7") is also located. At least three, preferably four or more locking balls (18) are arranged, distributed in a ring, in this case as well. The disk mounts (16, 17) have corresponding conical mounts (19) or mounts of another shape on their working surfaces for the centered mounting and guiding of the locking balls (18).

The clamping element (20) is designed in this variant as a tightening screw (21) with a spring (22), which extends centrally and at right angles through the ball ring. It extends in two aligned mounting holes of the disk mounts (16, 17). The mounting holes have a larger diameter than the shaft of the screw, which is guided at the ends of the hole by half shell-shaped insert elements, which are in contact with the screw head, on the one hand, and with the spring (22), on the other hand. The two disk mounts (16, 17) are connected to the tube sections (7', 7") by corresponding metal fittings (27) in a geometrically defined position.

Possibilities of deflection along the four axes explained in the exemplary embodiment according to Figure 3 are present in the variant according to Figure 4 as well. To absorb upsetting forces, the tube sections (7', 7") have a sufficient distance from the respective other disk mount (16, 17) at their ends. Moreover, a possibility of deflection along the other two translatory axes in the vertical and horizontal directions (out of the drawing plane) is also given in the embodiment according to Figure 4.

Detectors (24) of the above-described type may likewise be present in the deflectable safety device

(10) according to Figure 4. They are not shown in the drawing for clarity's sake only.

Figures 5 through 11 show three variants of the deflectable safety device (10), which is especially suitable for the crossed connection of device parts (6, 8), especially of tensioners or grippers or component centering means, etc., with frame tubes. The shaft or post (37) of the tensioners or grippers (6) is shown in the drawings.

The two safety device parts (11, 12) of the deflectable safety device (10) are of a similar design in the three variants, there being a positive-locking guiding with a spring-loaded locking element (13) in the exemplary embodiment according to Figures 5 and 6 and a frictionally engaged guiding in the variants according to Figures 7, 8 and Figures 9 through 11. A frictionally engaged guiding may also be present and act primarily in the variant according to Figures 5 and 6 as well, especially in case of locking springs set to a weak force.

One safety device part (12) is provided with the sphere as a ring-shaped collar (15') with an outer edge rounded in a spherical form in the three variants. The collar (15') is connected to the shaft (37) and is preferably made in one piece with it. The spherical rounding has the shape of a spherical segment, whose center (40) is the intersection of the central shaft axis (38) with the central plane of the ring collar (15'), which said central plane is located at right angles.

The second safety device part (11) is connected to the frame tube (8) or another device part in a suitable manner, e.g., by a clamp-like metal fitting (27) with exact positioning and optionally a positioning pin (29). The safety device part (11) has a socket, which is designed as a ring-shaped

calotte (14') and has an inner side rounded in a complementary and spherical manner. The rounding is designed as a spherical segment surface with the center (40) in this case as well. Due to this design, the safety device parts (11, 12) can rotate with their device parts (6, 8) about the center (40) in the manner indicated by arrows in Figure 5 when the deflectable safety device (10) responds. Axial displacement in the direction of the shaft axis (38) is not possible due to the connection between the safety device parts (11, 12), which is a positive-locking connection due to the spherical section shape.

To make it possible to mount the safety device parts (11, 12), the calotte (14') has a multipart design and comprises, e.g., two shell parts (30, 31), which meet at a transverse plane extending through the center (40) and can be connected and tightened by means of screws (32). Ground fitting plates are inserted at the contact point for an exact fit. This embodiment is again the same in the three embodiments according to Figures 5 through 11.

A locking element (13) is present in the variant according to Figures 5 and 6 for the positive-locking connection of the safety device parts (11, 12). It comprises, e.g., three locking balls (18), which are distributed uniformly over the circumference of the calotte, are acted on by a pressing spring (22) each as a tensioning element and engage correspondingly shaped and exactly defined mounts (19) on the outer circumference of the ring collar (15'). The spring force can be set by means of tightening screws (21). The locking element (13) also forms the adjusting means (33) at the same time for exactly positioning the safety device parts (11, 12) during the first assembly and each time after the deflection in case of a crash.

There is no locking element (13) in the two variants according to Figures 7 and 8 as well as according to Figures 9 through 11. There is a frictionally engaged guiding here between the calotte (14') and the spherical collar (15'). The frictional force is generated by means of the clamping connection of the shell parts (30, 31), which can be set correspondingly. In case of a corresponding setting and tightening of the shell parts (30, 31), such a frictionally engaged connection can also be obtained in the first variant according to Figures 5 and 6.

Another adjusting means (33) is present in the embodiments according to Figures 7 through 11. It comprises a plurality of adjusting elements (34), especially adjusting screws, which cooperate with corresponding mounts (35). One adjusting screw (34) is arranged lying at the safety device part (11) in the area of the calotte (14') and cooperates with a corresponding mounting opening (35) at the ring-shaped collar (15') of the other safety device part (12). The mounting opening (35) may be a blind hole according to Figures 7 and 8. The rotated and pivoted position about the shaft axis (38) and about the transverse axis through the center (40) can be set by means of this.

In the variant according to Figures 9 through 11, the mounting opening (35) is a slot (42), which extends along the axis (38) and is open upwardly and downwardly toward the adjusting element (34). Thanks to the slot (42), the safety device part (12) can rotate with its ring-shaped collar (15') about the two axes indicated by arrows in Figure 11 in relation to the above adjusting element (34) and deflect.

A second adjusting screw (34) is arranged in a projection (39) of the safety device part (11) having a C-shaped cross section in the design according to Figures 7 and 8. The projection (39) extends

over the shaft (37) at an axially spaced location. The second adjusting screw (34) is preferably aligned flush with the shaft axis (38) and engages a front-side mounting hole (35) at the upper end of the shaft. The rotated position of the safety device part (12) and of the shaft (37) about the longitudinal axis of the first shaft screw (34) can be set by means of this second adjusting screw (34). After the position has been found, the adjusting screws (34) can again be screwed back in their threads at the safety device part (11) and removed from the mounts (35).

The width of the spherical ring collar (15') and of the calotte (14') can be set differently as needed and according to the desired deflection behavior. The widths are preferably essentially equal in the exemplary embodiments being shown, the calotte (14) being able to be somewhat wider on both sides than the collar (15'). The resistance during deflection is determined by the ratio of the widths. The calotte (14') and the ring collar (15') may become disengaged in some areas during deflection in case of a small width, as a result of which the section modulus counteracting the deflection is reduced. The consequence of this is a faster and easier deflection, as a result of which deformations or other damage to the device parts (6, 7, 8) due to overload can be prevented from occurring.

A detector (24) is likewise present in the deflectable safety device (10) according to Figures 5 through 11. It comprises a contact switch or button, which is arranged in the projection (39) of the safety device part (11) and is positioned eccentrically and preferably in a direction obliquely to the shaft axis (38) in the variant according to Figures 5 through 8. The switch cooperates with a feeler (36) at the upper end of the shaft (37). Due to this eccentric arrangement, the detector (24) responds in case of all deflections about the center (40) and above all also during rotation about the shaft axis (38). The feeler (36) loses contact with the detector (24) during these deflections, and the

detector will then send a corresponding signal.

Figures 9 through 11 and especially the enlarged view in Figure 11 illustrate a design variant of the detector (24). The feeler (36) is designed in this case as a pressure piece (44), which is guided longitudinally movably in an upper tube section (43) of the shaft (37). The pressure piece (44) is acted on now on the rear side by a spring (46) in the tube section (43), and the spring force of this spring can be changed and set by an adjusting element (not shown). The pressure piece (44) projects upward from the tube section (43) with a rounded or conically shaped head part (45). The head part (45) comes into positive-locking contact with a complementarily shaped, conical or rounded mount (47). The mount (47) may be designed, e.g., as a ring-shaped socket.

The detector (24) has a microswitch or sensor (48), which is arranged in the projection (39) in the central axis (38) and comes into switching contact with the tip of the head part (45). In case of collision and deflection, the pressure piece (44) can yield elastically and become separated from the socket (47), while the microswitch (48) is actuated. The microswitch (48) may be of any desired technical type and design and is also not limited to the typical mechanical microswitches.

The microswitch (48) is guided movably along the axis (38) in a housing opening (51) and is acted on from the underside with a spring device (49), e.g., a compression spring, especially a plate spring assembly. The spring device (49) is supported at a laterally projecting collar of the microswitch (48). The microswitch (48) is acted on from the top by a clamping cover (50) in an adjustable manner against the force of the spring device (49). By actuating the tightening screws, the clamping cover (50) can be moved up and down along the axis (38). The detector (24) and the

elastic pressure piece (44) can thus be set exactly in relation to one another. The microswitch (48) can then be closed in the determined position and secured against undesired adjustment.

In this design, the detector (24) with its elastic pressure piece (44) is part of the adjusting means (33) operating in a positive-locking manner. This design has advantages in terms of manufacturing technology and signal engineering. The sensitivity with which the adjusting means (33) is triggered and also the sensitivity of switching of the detector (24) can be set and optimized by selecting the pretension of the spring. In addition, the design effort is reduced compared with the other exemplary embodiments.

The deflectable safety device (10) according to Figures 5 through 11 can also be used in conjunction with aligned device parts (6, 7, 8) similar to the variants according to Figures 3 and 4 in case of a corresponding conversion. The safety device part (11) has a correspondingly different shape in this case.

Various variants of the embodiments shown are possible. This applies, on the one hand, to the arrangement and the positioning of the deflectable safety devices (10) at the gripping device (1). The gripping device (1) may have, besides, a different geometric design and comprise other device parts (6, 7, 8). The frame (4) may be, in particular, plate-shaped or have another solid design.

Furthermore, the design embodiments of the deflectable safety device (10) and the parts (11, 12, 13) thereof may be modified as well. For example, more than two safety device parts (11, 12) may be present in intersections. The locking element (13) may comprise, as an alternative, one or more

geometrically defined, stationary stops at the safety device parts (11, 12), against which the respective other safety device part is pressed with a predetermined force. The triggering force may be able to be set in this case as well. In another variant, the locking element (13) may have shearing pins, which engage corresponding mounts (19), instead of one or more locking balls (18). The shearing pins consist of a suitable material, which breaks at a defined overload and thus makes possible a mutual deflection of the safety device parts (21, 22) while the positive-locking connection is abolished.

The design embodiment of the deflectable safety devices (10) may, moreover, be selected to be completely different by using, for example, electric buttons or sensors, which detect and report overload forces when collisions occur, but deflection of a device part (6, 7, 8) does not occur. Furthermore, it is possible to operate with electric, pneumatic and hydraulic switch-off safety devices, which function with or without deflecting movement.

LIST OF REFERENCE NUMBERS

1	Gripping device
2	Manipulator, robot
3	Robot hand
4	Frame
5	Docking point
6	Device part, tensioner, gripper
7	Device part, frame tube
7'	Tube section
7"	Tube section
8	Device part, frame tube
9	Safety means
10	Deflectable safety device
11	Movable safety device part, articulated part
12	Movable safety device part, articulated part
13	Locking element
14	Socket, tube section
14'	Socket, calotte
15	Sphere, joint ball
15'	Sphere, spherical collar
16	Disk mount
17	Disk mount]

18	Locking ball
19	Mount
20	Clamping element
21	Tightening screw
22	Spring
23	Junction point
24	Detector, sensor
25	Line
26	Control
27	Metal fitting
28	Recess, pan
29	Positioning pin
30	Shell part, calotte part
31	Shell part, calotte part
32	Screw
33	Adjusting means
34	Adjusting element, adjusting screw
35	Mount
36	Feeler
37	Shaft
38	Central axis, shaft axis
39	Projection
40	Center

41	Display
42	Slot
43	Tube section
44	Pressure piece
45	Head part
46	Spring
47	Mount, socket
48	Microswitch, sensor
49	Spring device
50	Clamping cover
51	Housing opening